Journal of the Royal Society of Arts

NO. 4892 FRIDAY, 6TH FEBRUARY, 1953 VOL. CI

FORTHCOMING MEETINGS

WEDNESDAY, 11TH FEBRUARY, AT 2.30 p.m. Two papers: (i) "*Increasing Beef Production*", by W. A. Stewart, O.B.E., M.A., B.Sc., Principal, Northamptonshire Institute of Agriculture; (ii) "*Increasing Milk Production*", by W. R. Trehane, Vice-Chairman, Milk Marketing Board. The Right Hon. the Earl of Radnor, K.C.V.O., a Vice-President of the Society, will preside.

THURSDAY, 12TH FEBRUARY, AT 5.15 p.m. COMMONWEALTH SECTION. HENRY MORLEY LECTURE. "*New Zealand's Place in World Trade*", by D. P. Taylor, M.Com., Trade Officer, Office of the High Commissioner for New Zealand. E. Marsden, C.M.G., C.B.E., M.C., M.I.E.E., F.R.S., Scientific Adviser in London to the New Zealand Government, will preside. (The lecture will be illustrated with a film. Tea will be served from 4.30 p.m.)

THURSDAY, 12TH FEBRUARY, AT 7.30 p.m. FILM EVENING. (See special notice.)

WEDNESDAY, 18TH FEBRUARY, AT 2.30 p.m. "*British Inland Waterways To-day and To-morrow*", by Robert Aickman, Founder and Vice-President, The Inland Waterways Association. The Right Hon. A. T. Lennox-Boyd, M.P., Minister of Transport, will preside. (The paper will be illustrated with lantern slides.)

MONDAY, 23RD FEBRUARY, AT 6 p.m. The first of two CANTOR LECTURES on "*The Safety Factor in Construction*", by G. Anthony Gardner, O.B.E., M.I.Struct.E., Chief Structural Engineer, Ministry of Works. (See syllabus below.)

TUESDAY, 24TH FEBRUARY, AT 5.15 p.m. COMMONWEALTH SECTION. "*Tsetse Fly Control*", by K. R. S. Morris, B.Sc., lately Director of the Department of Tsetse Control. J. W. Munro, C.B.E., M.A., D.Sc., Professor of Zoology and Applied Entomology, Imperial College of Science and Technology, will preside. (The paper will be illustrated with lantern slides. Tea will be served from 4.30 p.m.)

WEDNESDAY, 25TH FEBRUARY, AT 2.30 p.m. CADMAN MEMORIAL LECTURE. "*Improving Coal Production*", by E. H. Browne, C.B.E., M.I.Min.E., Director-General of Production, National Coal Board.

MONDAY, 2ND MARCH, AT 6 p.m. The second CANTOR LECTURE on "*The Safety Factor in Construction*", by F. C. Thompson, D.Met., M.Sc., Professor of Metallurgy, University of Manchester, and President, Institute of Metals. (See syllabus below.)

WEDNESDAY, 4TH MARCH, AT 2.30 p.m. "*The Assessment of Suitability for Employment*", by C. B. Frisby, Ph.D., B.Com., Director, National Institute of Industrial Psychology. D. W. Harding, M.A., Professor of Psychology, Bedford College for Women, will preside.

SYLLABUS FOR CANTOR LECTURES ON THE SAFETY FACTOR IN CONSTRUCTION

The syllabus for the two lectures to be delivered by Mr. G. Anthony Gardner and Professor F. C. Thompson, at 6 p.m. on Monday, 23rd February and Monday, 2nd March, will be:

LECTURE 1. General idea of safety factor. Criteria of structural failure—Fatigue. General complexity of the matter. Theoretical approximations. Beam theory as an example. Influence of type of structure on safety. Need for empirical investigations. Load *versus* stress criterion. Need for direct design methods. Analysis of items embodied in general factor. Materials and workmanship. Where the matter stands at present. Accidental loads. Conclusion.

LECTURE 2. Possible means of improving the strength of engineering materials, particularly ordinary constructional steel. Possible means of improvement by chemical, structural and mechanical techniques. Fruitful lines of research for the theorist, engineer and metallurgist.

Both lectures will be illustrated with lantern slides.

THIRD FILM EVENING

The third Film Evening of the Session will be held on Thursday, February 12th, at 7.30 p.m., and the programme will consist of the following films: *Oil for the Twentieth Century*, *Le Mans 1952*, and *The Train*. Fellows are entitled to introduce two guests, and light refreshments will be served in the Library afterwards at a charge of 1*s*. per head.

Oil for the Twentieth Century (30 minutes), which was made by the Pathé Documentary Unit and produced by Peter Bayliss for the Anglo-Iranian Oil Company, tells the history and growth of the company from 1901 to 1951. The great feature of the film is that it is made up of original authentic cinematographic material covering this long period and contains, therefore, such interesting sequences as moving pictures of traffic in London streets at the beginning of the present century. The story of the Company is set within a framework of world history, and various outstanding events are included.

Le Mans 1952 (32 minutes) was produced jointly by the Shell Film Unit and the Service Cinematographique Shell Français and directed by Mr. Bill Mason. While being an excellent racing film it possesses the added attraction of having the atmosphere of a popular festival. The shots of the manner in which the spectators, as well as the drivers, spent their 24 hours, is most entertaining.

The Train (17 minutes), a Swedish film produced by Sucksdorf, gives an impression of a journey from South to North Sweden, and by original photography, careful cutting and editing, and the skilful use of music specially composed by Sven Eric Back, a delightful sound and visual poem is created.

The Lecture Hall was full to capacity for the second Film Evening which was held on January 5th, and the programme was delightfully introduced by Sir Stephen Tallents.

RAW MATERIALS FOR PAPER

A paper by

GEORGE F. UNDERHAY, B.Sc., F.R.I.C.

Director, the Bowater Organisation, read to the Society on Wednesday, 26th November, 1952, with Kenneth Brown, President of the Newspaper Society, in the Chair

THE CHAIRMAN: As a publisher of newspapers and a general printer, I am naturally greatly interested in paper, and that interest projects itself to the manufacture of paper and to the question of the availability of raw materials which will ensure sufficient supplies being available for the growing needs of an ever more educated world.

It is not only the printer and the publisher who would be lost without paper; I think every single person in the world, whether educated or illiterate, is influenced at some time or other in his life by paper in some form. I dare say the Royal Society of Arts would be severely handicapped, although no doubt equal to the task of improvisation, if paper were not available. Reflect, if you will, on the large number of blisters and broken thumbs that are saved each year through the fact that its lecturers no longer find it necessary to record their learned addresses on stone!

I think we may agree that paper is valuable and that its continuity of supply is of intense interest to us all, and no one is better qualified to tell us about these matters than Mr. George F. Underhay. Mr. Underhay is a Bachelor of Science and a Fellow of the Royal Institute of Chemistry. He is chief chemist to the Bowater Paper Corporation Ltd., he is a Director of Bowaters Development and Research Ltd. and Bowaters Mersey Paper Mills Ltd. He is a member of the Executive Committee of the Technical Section, and Deputy-Chairman of the Technical Association of the British Paper and Board Makers' Association, and he is a member of the Advisory Board both of the British Paper and Board Makers' Association and the Printing and Allied Trades Research Association. He is also a member of a large number of other learned societies in this country and overseas, including the Canadian, United States of America, and Australian Technical Sections of the Board and Paper Associations in those countries.

You will see from that that he is very well qualified to speak to us on this subject, and as I know we are all anxious to hear him, with that short introduction I will ask him to give his paper.

The following paper was then read:

THE PAPER

Although paper and paper board are products which are very widely used, familiarity with the equipment for making paper and knowledge of the properties, sources of supply, and the quantities of raw materials required, are not common outside the industry. It is proposed, therefore, in addition to dealing with the main subject, to review briefly the factors governing pulp and paper

manufacturing processes so that the raw material problems to be discussed may be more readily appreciated.

CURRENT CONSUMPTION RATES OF PAPER

In 1950, the last year for which complete figures are available, the total quantity of paper and paper board consumed in the world amounted to nearly 42 million tons.* By far the greater part of the raw material for this very substantial total was provided by wood, the quantity of all varieties of wood pulp produced (excluding a considerable re-use of fibre in the form of waste paper) having amounted to 30 million tons.

The most recently available figures indicate that consumption is continuing to increase and, at current levels, it has reached the highest figures yet recorded. Some indication of the way in which the demand for paper has grown in recent times may be obtained from Table 1, where figures for the years immediately preceding the First and Second World Wars are compared with the totals for 1950.

TABLE 1

WORLD ANNUAL CONSUMPTION OF PAPER AND BOARD EXPRESSED AS MILLIONS OF LONG TONS

	Year	*Newsprint*	*Other qualities including board*	*Total*
United Kingdom ...	1913	0·5	0·6	1·1
	1937	1·3	2·1	3·4
	1950	0·6	2·5	3·1
Canada	1913	0·1	0·1	0·2
	1937	0·2	0·5	0·7
	1950	0·3	1·2	1·5
United States ...	1913	1·4	3·4	4·8
	1937	3·8	10·5	14·3
	1950	5·2	20·6	25·8
World	1913	—	—	11·2
	1937	7·9	21·1	29·0
	1950	8·9	33·0	41·9

Population increases, the spread of literacy, and the widening uses to which paper and paper products are put are all having their effect in increasing the demand. Only in the United Kingdom, as a direct result of war-time and post-war economy measures, is a decrease shown. Consideration will be given to the resulting raw material problems that have to be faced, when dealing in greater detail in a later section with the selection and availability of raw materials.

*All tonnages given in this paper are expressed as long tons (2240 lbs.), and since the last war they exclude Russia for which figures are not available. I should like to thank Miss B. A. Holford, B.Sc.(Econ.), head of the statistics division of the Bowater Organisation, for her valuable help in providing much of the data.

THE NATURE OF PAPER AND PAPER-MAKING FIBRES

That paper is essentially a fibrous material can readily be demonstrated by tearing a sample and examining closely the torn edge. Qualities such as towel paper, facial tissue, and blotting paper, all of which are opaque, low in density, and not particularly strong, show this effect readily; whereas papers like greaseproof, which are dense and translucent, do not reveal their fibrous structure so readily because the stock has been heavily beaten and the fibres, in consequence, have lost much of their original shape and form. The foundation of all paper none the less is predominantly fibrous, and it is from the world of growing cellulose vegetable fibres that the paper-maker draws his major raw material.

Almost any kind of tree or plant can be used for paper-making, but although the possible range of varieties is enormous, in practice the choice is narrowed down to a relatively few types selected because of their availability, the quality of the fibre that can be made from them, and the cost of producing a suitable pulp.

Pulping processes, by which fibres may be isolated from naturally occurring material and brought to a suitable state of purity and degree of fibre separation, consist either of chemical treatment, mechanical treatment, or a combination of both. Processes which have been practised successfully for many years include grinding wood by pressing 3 foot or 4 foot lengths against a revolving grindstone; alkaline cooking (usually under pressure) various materials including woods, cereal straws, grasses, and rags, using caustic soda alone or caustic soda and sodium sulphide; and acid cooking, under pressure, using calcium bisulphite solution for the digestion of non-resinous soft wood.

In mechanical grinding, an extensively used process suitable only for wood, the ground-wood pulp produced is obtained by the purely physical process of tearing the fibres from the log, with quantities of water showered on the grindstone; practically all the original constituents of the wood remain with the pulp. In chemical processes, however, the aim is to dissolve out most of the non-cellulose material, thus freeing the fibres from the cementing substances (chiefly lignin) and isolating them as a fibrous pulpy mass composed of true cellulose and some related compounds. Newer processes, mostly developed for special purposes, involve the use of neutral sodium sulphite (particularly suitable for hardwoods and straw), the production of high yields by refining hot partially cooked wood chips, and multi-stage digestion in which preliminary alkali treatment is followed by chlorination, further alkali treatment, and multi-stage bleaching. The colour of most pulps can, where necessary, be improved by some form of bleaching treatment.

The fibres present in plant life all have typical length and other characteristics which vary with the species. The more common type of paper-making fibres range from a length which may be as short as 1 mm. or less, for hardwoods, esparto grass and cereal straws, through the medium lengths which include spruce and pine fibres (length up to about 5 mm.) to the long fibred materials examples of which are cotton (up to 4 or 5 cm.) and flax (up to 6 cm.). Differences not only in the length but in the width, wall thickness, fibre structure, and

physico-chemical properties are of great importance to the paper-maker, and all these factors, as well as the overriding one of cost, are carefully considered in selecting the fibre best suited to the quality of paper to be made.

In times of paper shortage, such as have been experienced after each of the world wars, when raw materials appear to be very scarce, dozens of possible alternatives are pressed on the paper industry for their urgent consideration. Examples of these, available in this country, are fruit tree prunings, hop bines, the common nettle, and sawdust. It is possible to make paper from all of these and hosts of other materials, including grass mowings from the lawn, but

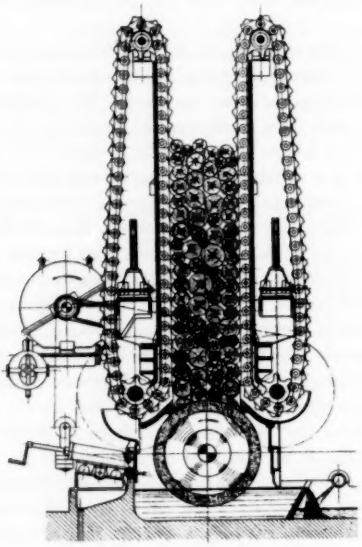


FIGURE 1. *Continuous chain grinder showing logs being pressed against a revolving grindstone*

even if the fibre quality is good (the common nettle, for instance, has an outstandingly good fibre), collection and transport costs are almost invariably far too high and the yields obtainable are often low. In spite of these well-known facts, however, proposals for using materials of this kind are put before the paper industry with great regularity, and it is not always easy to convince the well-intentioned enthusiast that his suggestions are not practicable.

Cellulose fibres have several characteristics in common, which are very important from the paper making point of view. In addition to having good strength as individual units, adequate length and flexibility, and a degree of resistance to chemical attack important for digestion processes and for paper

permanence, fibres are endowed with an ability to stick to one another by virtue of the nature of the cellulose and the small quantities of closely related substances, including particularly the hemi-celluloses, which go into the composition of the fibre. During the present century there has been much speculation and study in connection with the forces that are responsible for this cohesive ability; a brilliant chapter of investigation in this field, revealing the structure and properties of cellulose, has enabled the conclusion to be drawn that it is a type of linkage, on the border line between physical and chemical forces and now well-known as hydrogen bonding, which, operating through the presence of the hydroxyl groups occurring regularly in the ultimate cellulose chain, enables fibres, under suitable conditions, to stick strongly enough to one another to produce paper. Although a little remote from the actual process of paper-making, as the practical man sees it, two sets of very much simplified illustrations, Figures 2 and 7, have been included in an attempt to illustrate how modern science has been able to provide an explanatory picture of the fibre and its properties.

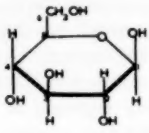
How far the hydrogen bonding can be made available to the paper-maker for building up strength in his sheet depends on the construction or morphology of the fibres, the degree of crystallinity of the cellulose, the amount and the nature of the near-cellulose and other constituents present, and the extent to which mechanical beating can be used to bruise and fray the fibres so that areas of contact between fibre and fibre, when made up into a sheet of paper, may be increased.

It is interesting to note, incidentally, that fibrous materials which do not have all the attributes of cellulose can be made into paper; special treatment has to be given, however, to offset the defects. Asbestos, for instance, of which considerable quantities of paper are manufactured, is composed of mineral fibres having no natural mechanism that can be used to enable them to stick to one another. In consequence, an adhesive has to be added, usually in the form of an organic binder such as starch, to bind the fibres well enough together to form a sheet sufficiently strong for the purpose. The extra difficulties involved in making paper from materials of this kind are justified, of course, only because of special properties in some other direction; asbestos paper, as is well known, is used extensively for fire resistance purposes.

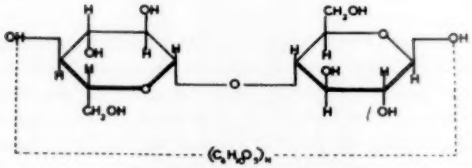
THE PAPER-MAKING PROCESS

From the point where the chosen vegetable fibre has been isolated in a suitably pulped condition, to the manufacture from it of paper of the desired quality, there is the paper-making process proper which, for modern continuous production, necessitates complex and costly equipment. In this country, a high-speed machine of the most advanced type and capacity, as used for producing newsprint at a rate of some ten tons per hour, costs nearly half a million pounds, exclusive of buildings and the multiplicity of pumps, chests, piping and stock treating equipment that is required. Over 3,000 h.p. is required to operate such a machine and low-pressure steam, to be consumed at about twenty-five tons per

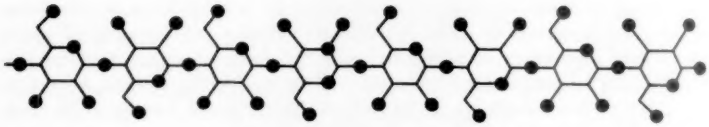
hour, is needed for drying the paper. Right at the opposite end of the scale, paper can be made by hand on hand moulds and, to satisfy the demand for very high quality rag writing and document papers, the one or two hand-made mills still existing in this country continue to produce very attractive products both for the home and overseas markets.



β-GLUCOSE



CELLOBIOSE



CELLULOSE CHAIN M 300 X 10³: 1

FIGURE 2. *This figure, which is complementary to Figure 7 (page 162) shows in detail the simple glucose molecule and two glucose units joined together to form the essential chemical unit cellobiose of which a pure crystalline cellulose chain, seen diagrammatically in the third illustration, is built*

The essence of the method of making paper by hand, involving as it does the filtering on a fine wire of a suspension of stock in water, remains as the essential basis of paper-making processes to-day whether the machines are large or small. The discontinuous and extremely slow hand operation, however, has been almost entirely displaced by continuous production methods, the principle of which, applied to the most commonly used type of machine, the Fourdrinier, is illustrated in Figure 3.

A dilute suspension of well mixed and properly treated stock of a concentration

around 0·5 per cent is poured, evenly and continuously, from a very shallow rectangular orifice, called the slice, directly on to an endless wire. The issuing stock has the appearance of a liquid ribbon half an inch thick and covering nearly the full width of the wire. Travelling immediately below the slice and at about the same speed as the issuing stock, the wire is supported horizontally on rolls in the manner of a belt conveyor. Drainage of water through the wire starts immediately the stock flows on to it, and, aided in the later stages by vacuum applied to the underside, the fibres, most of which remain screened out on the top of the wire, gradually become formed into a felted and very immature mass of paper. In this process the original 0·5 per cent stock becomes concentrated up to an exceedingly wet sheet containing about 20 per cent of fibre and 80 per cent of water at the far (couch) end of the wire. Here the wire returns to the slice, and the sheet, though extremely fragile, has to be picked off, transferred without breaking on to absorbent felts, and passed on them through two or three heavy presses where further water is removed by squeezing, thereby consolidating the fibres into a denser and somewhat stronger web. The moisture content will now have been reduced about as far as is possible by the draining and pressing processes, and the sheet will contain some 35 per cent of solid material and 65 per cent of water. Beyond this point, removal of water has to be accomplished by evaporation, the usual procedure being to pass the paper over a series of steam-heated cylinders followed by calendering. When finished and ready for the customer, paper usually has a moisture content of around 8 per cent.

This much abbreviated description of how paper is made will serve to introduce the important point that fibrous raw material chosen for any particular purpose must have properties which are suitable not only for the quality of paper wanted but also for the process by which the paper is made. In the continuous process, the stock on the wire must not hold on too tenaciously to the water in which it is suspended, otherwise the draining, pressing and drying operations will be hindered. On the other hand, it is necessary, by appropriate mechanical beating and refining treatment, to bruise, fibrillate, and perhaps shorten the fibres to the extent demanded by the quality of paper aimed at. These treatments inevitably make water removal more difficult and machines that have to make paper from heavily beaten fibres have to be given more time for the water to get away, and they usually have to operate more slowly than would otherwise be the case.

Figure 4* shows an example of what is termed "a free pulp" prepared by the kraft process. The fibres have not been beaten, they are of medium length, slender, and it will be seen that they are unfibrillated and substantially undamaged. In consequence, water can be drained away quickly and the immature wet sheet can be handled well on a paper machine. The final sheet would have only moderate strength and be rather bulky.

*For the excellent photomicrographs of fibres and for help in the preparation of other illustrations, I am very much indebted to B. H. Browning, F.R.M.S., a senior scientist of the Bowater Organisation.

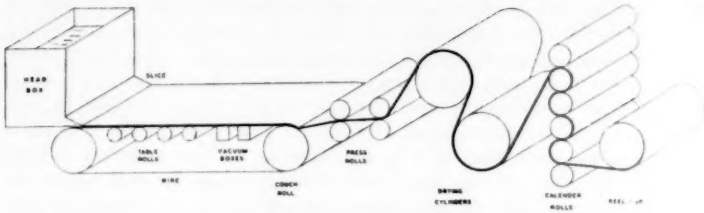


FIGURE 3. *Diagrammatic view of continuous paper-making on a Fourdrinier machine. The sheet of paper being made is represented by the thick line. (The number of drying cylinders used in practice is much greater than the two shown)*

After heavy beating the fibres take on a very different appearance (see Figure 5). They are split and frayed and part with water very much less readily. Paper made from such a heavily beaten stock will be relatively dense and strong.

In addition to controlling the mechanical treatment of pulps to give required characteristics, the papermaker is very alive to the fact that fibres from different kinds of raw materials differ very much from one another both in their initial and in their developable properties. Different methods of cooking the same raw material can also give rise to wide quality ranges. These differences have to be recognized and used to the best advantage both for the operation of the paper machine and also for the production of the required paper. Esparto grass, for many years a raw material exclusively and most successfully used in the United Kingdom, characteristically gives opaque, bulky paper of good uniformity and excellent printing qualities; pine cooked by the sulphate or kraft process (caustic soda and sodium sulphide) is particularly good for strong wrapping papers; and ground-wood prints well, has excellent opacity and, being at the same time relatively inexpensive, it is used extensively for the manufacture of newsprint and magazine papers. Blotting paper is an example of a very bulky, free sheet the furnish of which usually contains mostly rag fibres that have been cut in the beater to increase the water absorption properties and help sheet formation.

As well as controlling quality by selecting and appropriately treating fibres, paper can be impregnated, waxed, coated, and generally treated in a variety of ways which give a tremendous range of qualities and properties. It can also be laminated to similar or dissimilar materials, and plain or corrugated boxes, fibre drums, and even constructional materials, manufactured essentially from a paper fibre base, can be produced.

An interesting speciality which has comparatively recently been popularized in this country is the range of wet strengthened qualities of paper available for towelling and packaging. The process, largely developed in the States just before and during the war, was of importance for making tough map paper which could stand almost unlimited soaking by water without disintegrating. Reference has already been made to the hydrogen bonding in ordinary paper, a bonding

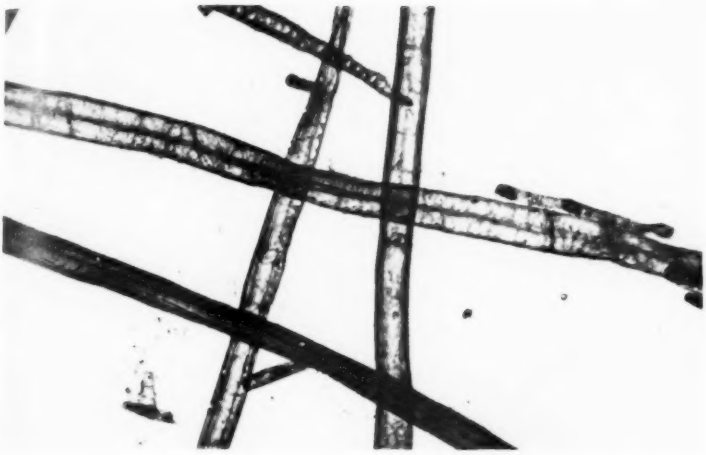


FIGURE 4. *Unbeaten fibres of kraft pulp*

FIGURE 5. *Kraft pulp heavily beaten*

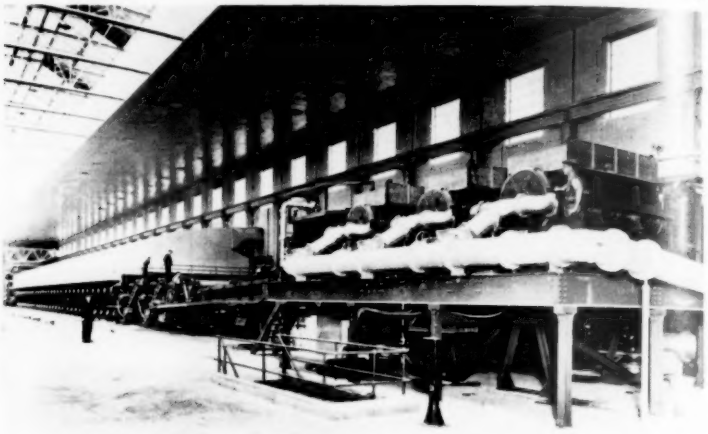
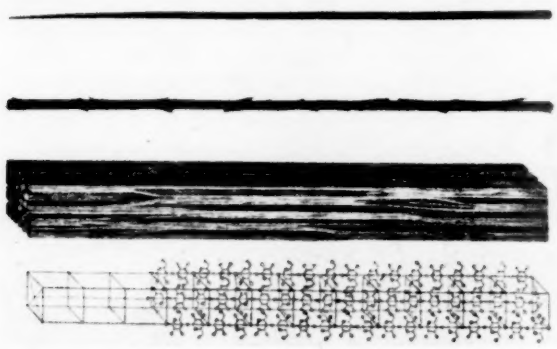


FIGURE 6. *View of the world's largest paper machine operating at Kemsley, near Sittingbourne, Kent*



[*After A. Frey-Wyssling*

FIGURE 7. *Illustrates in a much simplified and idealized form, a fibre and its component parts:* (a) *One end of a flax fibre is shown: a complete flax fibre is long, usually somewhere between 1 and 6 cm., and the width is between 14 and 20 microns (1 micron = 1/10,000th of a cm.).* (b) *Fibrils are somewhat ill-defined, but the width may be around $\frac{1}{4}$ of a micron and the length is indefinite.* (c) *Working still further towards the ultimate structural components, this attempts to show that the crystalline cellulose contained in fibrils is not continuous but there are voids and amorphous regions between the bundles of crystalline chains.* (d) *The ideal cellulose lattice or crystal, composed of glucose units in chain formation: it is believed that chains of this kind, hydrogen bonded parallel to one another and probably joined up at the ends by amorphous material, form the so-called micro fibrils (width about 1/100th of a micron), and these, in turn, in bundles and with additional amorphous material and voids, make up the fibrils already described*

which, in the presence of water, is likely to be broken down fairly quickly by a process not unlike that which occurs very much more rapidly and completely when sugar is dissolved in water. In wet strengthened paper, however, the bonding is strengthened by the use of small quantities of materials, such as melamine or urea formaldehyde and, after the usual paper machine heat drying and some maturing, it seems probable that some degree of bonding more nearly approaching to a true chemical linkage is brought about. Although the mechanism is not yet fully understood, the important result is that the paper is much less readily broken down when saturated by water.

SELECTION AND AVAILABILITY OF RAW MATERIALS

Before dealing with the main question of adequacy of supplies of suitable qualities of paper-making fibre, now and in the future, it should first be noted briefly that there are many important auxilliary raw materials not so far mentioned which, although used in very much smaller quantities, have none the less an important role to play in creating the most appropriate paper quality for particular uses.

In tonnage the most important of these non-fibrous materials in this country is china clay. The total quantity used for paper in Great Britain approaches 200,000 tons annually, and the Cornish mines do important dollar earning export business with paper mills in North America. China clay is mixed in with pulp to improve the opacity, printability, and the brightness of printing papers; the amount used may vary from a few per cent up to 10 per cent or more of the finished paper. Extra fine qualities of clay are used for surface coating, a suitable adhesive, such as starch or casein, being mixed with the clay to bind it securely to the paper. There are many other mineral loading and coating materials used on a much smaller scale than china clay but selected because of some important property that may not be given by china clay. Thus titanium oxide, though considerably more expensive than china clay, finds a place in the industry because of its particularly high degree of whiteness.

For controlling acidity during manufacture, for fixing dyes, and for precipitating rosin size to develop water resisting properties, paper-makers' alum is an important auxilliary raw material. Dyes are used, of course, in great variety to produce heavy or light colours and also to brighten the shade of near white papers. For the production of papers for special uses by converting operations subsequent to the operations of the paper machine proper, many different kinds of coating and impregnating materials are available. One of the most inexpensive, paraffin wax, is used extensively for making waxed papers which have a high degree of water vapour and water resistance. In more recent times the plastics industry has provided new and more specialized materials, including polyethylene and polyvinyl chloride which, when coated on to paper, can combine resistance to moisture, mineral oils, and chemicals, with a high degree of flexibility giving almost complete freedom from cracking when creased. Gelatin is a much more common material which has been used since the early

days of paper-making for the surface coating (tub sizing) of good class writing papers to make them resistant to ink. The list could be continued indefinitely, but, from what has been said, some idea of the variety and uses of these auxiliary non-cellulosic raw materials will have been indicated.

In coming now to the most important raw material, paper-making fibre, the problem of providing adequate quantities of materials of suitable quality to satisfy world demands, at the present time and in years to come, merits careful examination.

It has already been noted that the world total usage of paper and board is over 40 million tons annually. This represents an estimated consumption of 45 lbs. a year per head of the population; 45 lbs., however, is only the average of figures which show great differences from country to country. The United States heads the list with a figure approaching 400 lbs.; this is in striking contrast to the figure for the continent of Asia where the consumption is only 2 or 3 lbs. per person. In Northern Europe the figure is around 115 lbs., and in the United Kingdom it is about 138 lbs. Thus, if the high consumption figures per head of the population per year for the most advanced countries are to be followed in due course by those areas of the world where education and modern standards of living have either not begun to operate or have not yet had their full impact, then indeed the world demand for paper and, therefore, for the raw materials to make it, will be very great indeed. In a contribution[1] to a recent conference on this subject in this country, I. G. Burns and J. Grant believed the lower figures in course of time, perhaps as far as a century ahead, would rise to the American level, the result of which would be an enormously increased demand for paper. A rise in consumption of only 10 lbs. per head of the population of the world would call for an increase in production of some 10 million tons of paper and board. The future, therefore, may well hold out a prospect of great increases in the demand for paper and board, especially when it is realized that in the figures given no account has been taken of the fact that countries with high rates of consumption, such as the United States, show no signs of having reached saturation point; the figures are still rising.

In the face of this picture, what are the prospects of the world being able to meet the greatly increased demands likely to be encountered?

In the history of paper-making there have been many scares about the availability of raw materials. A few of the scares have been real, but only so far as the particular raw materials in use at the time were concerned; most of them have been false. There was, for instance, real concern in the middle of the nineteenth century when, owing to the growth of the population of this country and the increase in literacy, the demand for paper and books was stretching to the limit the ability of the main raw material then available, rags, to provide the necessary supplies. At this time[2] prizes were offered both by the Royal Society of Arts and *The Times* newspaper for a substitute for rags for paper-making and, in about 1860, copies of *The Times* newspaper were printed on paper made from mixtures of rag and straw. The use of straw did not persist at that time, however, because other materials (such as wood pulp and esparto) subsequently took its

place, except for the manufacture of brown strawboard which eventually became a Dutch speciality owing to the cheapness and ready availability of straw in that country. The introduction of wood, and to a much less extent esparto, as a source from which good quality pulp could be obtained was a major factor not only in enabling greatly increased supplies of paper to be available, but also in reducing the cost of paper.

Of the false scares we have just had one more example in this country in the years immediately following the Second World War; the industry has emerged from this only in recent months.

Shortages such as we have just experienced are due not to lack of the primary raw materials but to a variety of other causes including serious slowing down of the normal expansion rate of mills during the war years; a demand which is high in relation to productive capacity and stocks; and, to some extent, to a temporarily reduced level of immediately available raw materials due to abnormal cutting of timber in countries isolated by the war from their normal raw material supplies. Under these circumstances prices soar, all too often completely out of step with costs, and would-be exploiters of a great variety of both ordinary and extra-ordinary alternative raw materials endeavour to turn the situation to their advantage by talking of a decline in wood supplies and showing how well the costs of their alternative raw material compare with the ruling prices (not, however, the costs) of conventional pulps. Pulp and paper mills use heavy equipment the capital cost of which is high in relation to the value of the product. To meet increases in demand, particularly during the years immediately following a war, a period of several years may be needed, and thus it takes time to satisfy market requirements. During this period, worried converters and sellers endeavour to build up greater stocks than they normally carry, and these factors further exaggerate the gravity of shortage conditions.

An example of the effect of this on pulp prices in recent years may be given. Strong kraft or sulphate pulp, suitable for making brown paper and liner board for packaging purposes, was selling in the decade before the Second World War at prices of less than £10 per ton. Since the war, scarcity value has enabled manufacturers to obtain prices well in excess of £100 but the recent sudden change to a buyers' market has brought the price down to less than £40. Once again prices are settling down at a level which bears a reasonable relation to costs, and, having examined how post-war manufacturing conditions compare with pre-war conditions, L. G. S. Hebbs[3] has recently suggested as a guide that price levels of not more than four times pre-war figures may be regarded as the maximum permissible cost when examining new projects. The figures given for kraft pulp are in line with this view. The point to emphasize, however, is that at the greatly inflated prices that prevail in time of shortage alternative raw materials may look attractive, but in most cases the attraction will be short-lived, unless the world's major raw material, wood, really begins to decline in availability.

All the indications at present are that now, and probably for many years to come, ample wood supplies (supplemented to a small extent in various parts of

the world by indigenous raw materials that have been found to be profitable for local use) will be available to meet both the existing and future needs of the paper industries of the world. Indeed it seems likely that wood will retain its place, perhaps indefinitely, as the most important raw material for paper-making both because of its inherent suitability and also because, for the majority of countries, wood pulp can be made available at an economic price. If complications should arise they may perhaps come because of competition from other interests such as the timber and the rayon industries.

These views are based both on the history of wood usage and also on the trend evident in recent developments. In place of wood varieties that have ceased to be accessible because of too heavy cutting new methods have been developed of using trees formerly thought unsuitable for pulping; yields have been increased, sometimes spectacularly, by improved digestion processes; saw and pulp mills are being integrated to the advantage of both; great attention is being paid to the need for operating on a sustained yield basis; and forest management is being improved, resulting in controlled cutting and substantial reductions in losses due to fire and pest. All this is in addition to the prospects of opening up new forest areas hitherto untouched.

In the United States, the shortages that have arisen from the unwise denuding of the softwoods that used to flourish in the North East and Middle West States are being alleviated to some extent by the pulping of hardwoods not previously used, and by afforestation. Furthermore, the rapid development of the use of Southern pine for making kraft paper and board, and for newsprint, and the vigorous developments on the N.W. coast have greatly contributed to the healthy state of United States industry. In 1925 the production of paper and board from the Southern States was given as rather less than half a million tons a year; by 1937 it had risen to 1·3 million tons, and in 1950 the figure was 7·3 million tons. On the west coast, in the Washington and Oregon areas, paper and board annual production had risen to 1·3 million tons by 1950 having been only about a tenth of that figure in the early 1920s; this industry is based on the huge hemlock and Douglas fir trees that grow to the west of the Cascade range and are accessible to the mills located on the coast. These operations are closely integrated with the timber industry, using much of the waste rejected by the saw mills. Increasingly effective forestry methods are ensuring that the rate of cut and depletion on the west coast and in the south does not exceed the rate of growth; and in the north east some progress is being made towards the re-stocking of those areas with softwoods. In addition, there are the vast untapped wood resources of Alaska which are now under consideration.

In Canada, the total production of the pulp and paper industry during 1950, 7·6 million tons, was half a million tons more than it was in 1949, and R. M. Fowler[4] reported in 1951 that in both domestic and international trade the Canadian pulp and paper industry was the largest single factor in Canada's prosperity. By 1951 the gross production of all products had risen to 8·5 million tons (of which 4·9 million tons were newsprint), representing an increase of nearly 40 per cent in five years. To keep pace with these high figures, Fowler[5]

states that there was a record total wood cut in the preceding season of some twelve million cords (the quantity of wood contained in an orderly pile of 4 foot logs, 4 feet high by 8 feet long). Although this 1950–51 crop was the highest in history, Fowler notes that it represented altogether only an eighth of a cord per acre over the 142,000 square miles of forest under lease to the industry, and there are estimated[5] to be over a million square miles of forest area in Canada out of which 470,000 are regarded as being accessible. It is interesting to compare these figures with those of a Northern European country. Sweden[6] for example, on a perpetual yield basis, produces a total of 3·5 million tons of pulp of all kinds from 75 thousand square miles of coniferous forest. This gives a perpetual yield of 47 tons of pulp per square mile compared with Canada's figure of 17 tons calculated from an output of 8 million tons and the potentially available area of 470,000 square miles. Thus there seem to be no signs that Canada is within sight of a limit to her raw material supplies. Production is steadily rising and only four months ago a completely new mill[7], Elk Falls, on Vancouver Island, started up the one machine which is planned eventually to reach a productive capacity of 90,000 tons a year. The necessary wood, hemlock, Douglas fir, and spruce, will be available in perpetuity on a sustained yield basis. This is but one of the mills on the British Columbia coast where altogether over half a million tons of paper and board are now made annually; and areas like Labrador, which is being investigated at the present time, have not yet begun to be exploited.

Altogether in North America the total production in 1950 was over 20 million tons[8], and expansion of production has continued at such a rate during the last decade that, averaging an increase annually of 700,000 tons, it has almost equalled the pre-war world expansion rate—and all of it is due to wood.

So far, only the North American continent has been considered, but it is significant that there, where production, almost entirely from wood, accounts for over 60 per cent of the world production of pulp, no wood shortage is apparent either now or in the foreseeable future with a steadily expanding industry. What then is the position in other parts of the world? Scandinavia and Finland are probably near their cutting limits and, wisely, these countries are taking every precaution to ensure that cutting does not exceed the annual rate of growth. Russia[6], in pre-war years, was estimated to have 425 thousand square miles in its European territory; roughly equal to the Canadian accessible area and also to the United States forest area. Now the iron curtain has encompassed a considerably increased area of pulp wood forest, and very little is known about the present position there; no Russian tonnages, therefore, are included in the post-war figures reproduced in this paper. France is an interesting example of a country where a man-made forest supplies a useful proportion of her needs. In the sandy hinterland of the Bordeaux area maritime pines were planted extensively some years ago to hold together the light sandy soil. These forests formed the basis firstly of a rosin industry and more recently of a paper industry, which is now of much greater importance than the rosin industry. A similar stand is now being exploited at the present time in Portugal, though on a small

scale. Moving right to the opposite side of the world, there is another example, much in the news, where a man-made forest, the largest in the world, is to be utilized in connection with the Munipara project in New Zealand. It is a project planned to be integrated with timber developments and to produce, in the first instance, some 100,000 tons of pulp and paper a year from the Monterey pines (*pinus radiata*) of the 400 square mile Kaingaroa forest. Right near by, Australia, amid many difficulties, has for some years been quietly and effectively developing the use of a hardwood tree, the eucalyptus, not previously considered suitable for paper-making. Only 1 per cent of the total area of Australia is reserved for forestry, and of this only about half is considered good forest country (Sweden has 55 per cent, Canada 33 per cent, France 18 per cent, and the United Kingdom 5 per cent)[8]. Another difficulty is that, although there is some pine (*pinus radiata*) in South Australia and Victoria, this comparatively long-fibred soft wood is too much in demand for timber to be made available for pulping, and the paper industry has to be content in the main with short fibred eucalyptus hardwood. Despite these and many other disadvantages, however, Australia's story has been one of success with difficult raw materials and the production of paper and board, half of it from indigenous wood, is now over 200,000 tons a year; consumption is twice that figure the difference being made up by importation.

This very sketchy and incomplete survey, supplemented, however, by the details given in Table 2, of the world pulp production for 1950, and supported by the growing efforts to utilize forests, on a perpetual yield basis, provides encouraging and sufficiently solid indications, it is believed, to negative the unauthoritative and short-sighted statements that suggest that wood has had its day and that alternative raw materials are urgently required.

TABLE 2

WORLD TOTAL PRODUCTION OF WOOD PULP IN 1950, EXPRESSED AS MILLIONS OF TONS AND EXCLUDING RUSSIAN CONTROLLED AREAS

Europe		*North America*	
United Kingdom ...	·12	United States ...	13·22
Norway	1·00	Canada	7·57
Sweden	3·11	Mexico	·07
Finland	1·88		20·86
Denmark	·001	*South America*	
France	·49	Brazil	·14
Belgium	·08	Argentine	·03
Netherlands ...	·12	Chile	·02
West Germany ...	·90		·19
Austria	·34	*Other Countries*	
Spain	·03	Australia	·09
Portugal	·006	New Zealand ...	·02
Italy	·18	Japan	·74
Switzerland ...	·14	Turkey	·01
	8·40		·86

Totals

North America	20·86
South America	·19
Europe	8·40
Other countries	·86
	30·31*

The fact that wood has many important advantages, combined with the knowledge that there are great resources of suitable pulping varieties available to man, does not mean, however, that there is no room for the exploitation of other materials. It has not proved possible to obtain complete details of the world usage of fibrous raw materials other than wood, but, so far as the present overall picture can be judged[2], it would seem that not more than 10 to 15 per cent is likely to be added to the wood pulp supply by alternative raw materials. This statement, of course, excludes the very substantial use of waste paper which undoubtedly will continue.

Of the possible alternative materials available in modest quantities, but very much talked about just now, bagasse, the waste material remaining after the sugar has been extracted from the cane, is being boosted far beyond its potentialities and, amongst other things, it is being proposed as a competitor to newsprint made from wood in North America. The true position, however, was soberly and authoritatively summed up last month[9] by an organization owning a combined sugar and paper making plant at Paramonga, Peru, where bagasse has been used as part of the paper furnish for twelve years. This statement reads: "on the subject of newsprint from bagasse we consider . . . that its manufacture in the United States would not be especially attractive from an economical point of view . . . we do not consider bagasse will ever become an important source of newsprint. In foreign countries having adequate supplies of bagasse, it could best be utilized to produce that country's needs for newsprint and other paper rather than for export." Some of the reasons for this conclusion are that bagasse, containing as it does 50 per cent of moisture, would present a costly transport problem; that the fibre is much less adaptable and useful than wood; and that, in any case, the average sugar mill which produces refined sugar has no surplus bagasse as it is used as a fuel. Thus, the truth of the matter is that where bagasse is available and suitable markets exist or can be developed, the material can be used for both paper and board manufacture. Indeed, in addition to Paramonga, one mill is operating in India and another in the Phillipines. Furthermore, one or two mills are under construction in other parts of the world where there is some surplus of bagasse, but the scale of all these operations is very small compared with wood pulp operations.

Similar stories may be told of other sources of fibre. Local conditions, natural or protected, may well justify the use of locally available materials, but successful

*About 1½ million tons of which is dissolving pulp for rayon and similar materials.

local exploitation does not prove that a material is of world wide interest. A prominent example of this near at hand is the use of straw in Holland, where farmers and paper board interests have for many years co-operated very successfully in the establishment of an efficient and competitive industry. Supplies of straw are by no means unlimited, however, and Holland requires and uses considerable quantities of wood for newsprint manufacture and for making other classes of paper.

Here, too, in Great Britain, although wood is the most important raw material for the paper industry, there is room in our domestic economy, and on a competitive basis, for other raw materials. It may be of interest here, briefly to examine the position. In 1950 the total United Kingdom output of paper and board was 2,614,000 tons[10], consumption being 3,070,000 tons[11]. To produce this output the industry used 1,220,000 tons of wood pulp (48 per cent including 6 per cent of home produced pulp), 300,000 tons of esparto grass (5 per cent as pulped), 100,000 tons of straw (2 per cent as pulped), 135,000 tons of rags (4 per cent as pulped), and 880,000 tons of waste paper (30 per cent as pulped). The total percentage of these raw materials in pulped form adds up to 89 per cent of the furnish of the 2·6 million tons of paper and board produced. The difference is partly accounted for by the 170,000 tons (7 per cent) of china clay consumed in the industry.

This picture shows that in the United Kingdom in 1950, some 54 per cent of the furnish required for paper-making was processed in this country, a small quantity of it (10 per cent), from indigenous materials (straw 2 per cent, china clay 7 per cent, and home grown wood 1 per cent) and the remainder from waste paper (30 per cent), esparto (5 per cent), imported wood (5 per cent) and rags (4 per cent).

How far can this small but encouraging trend towards providing our own raw materials be advanced? The utilization of more straw might appear to be one answer. Although its inherent quality characteristics make it less generally adaptable than wood pulp, straw, when produced by modern methods in an integrated mill located not too far from the producing areas, is competitive both in the form of raw cooked brown pulp, and also when converted into bleached pulp. In spite of optimistic reports, however, straw supplies for paper-making have not been proved to be so steadily available in the required quantities as to give the paper industry confidence that capital spent on additional plant would be justified. Even if the exceptionally high usage of 350,000 tons a year reached during the war could be sustained, it would not provide more than six or seven per cent of this country's pulp requirements at the present levels.

As an additional source of entirely home produced supplies of pulp, it is hoped that the efforts of the Forestry Commission may enable an appreciable increase to be made in the present very small quantity of home grown wood used here for paper-making. Following experience gained during the war years, one mill has been able to use home grown wood, over considerable periods, at a rate of some 1,000 tons a week for making paper and board. The Forestry Commission's present plans[12] provide for the growth of some 8,000 square miles of effective

forest in Great Britain (partly from existing woodlands and partly by afforesting bare land), and in 1960 it has been estimated that it will be possible, from thinnings in the coniferous crops, to obtain some 24 million cubic feet, or roughly 200,000 tons of air dry wood. This alone, even if it were all suitable for pulp making and available to the paper industry, would only be a very small contribution to the home produced pulp problem, but no wood other than thinnings is included in this estimate. Nevertheless, the difficulties in the way of increasing appreciably the proportion of entirely home produced pulp used in these islands are considerable.

From the point of view of the world situation, however, the problems of pulp availability in the United Kingdom are small; and the world position, seen as a whole, is encouraging. Perhaps one of the most important signs is that, increasingly, efforts are being made to harvest wood as a crop which must not be destroyed by over cutting; strictly applied scientific control must ensure that the amount of wood taken from the forests does not exceed the annual rate of growth. Figures to show the kind of quantities involved, in most cases, are not at all accurately known, but from various sources of information Table 3 has been drawn up to give a very rough idea of the tonnages of sustained yields obtainable in different parts of the world.

TABLE 3

YIELDS PER SQUARE MILE PER YEAR OF WOOD OR WOOD PULP FROM VARIOUS FOREST AREAS

Wood	*Location*	*Established or estimated usage, sustained basis*
Spruce, balsam	Newfoundland	26 tons; pulp of all kinds, including integrated, calculated from total pulp production and forest area available at one newsprint mill.
Various	Canada as a whole	17 tons*; pulp of all kinds including integrated, calculated from total pulp production and total accessible forest area.
Spruce, pine	Sweden	47 tons*; ditto
Monterey pine (*pinus radiata*)	New Zealand	230 tons*; calculated from proposed initial pulp and paper output and forest area available for Munipara project. This is well within the high rate of growth figure of 1,000 tons dry basis, estimated from forestry surveys.

Careful examination of comparable figures of this kind strongly suggests that, by more intensive forestry, it should be possible to improve substantially the

*These yields are additional to quantities extracted for saw mill use.

sustained yields obtainable in many important wood producing countries. The Canadian yield, for instance, appears to be only a little more than one third of that of Sweden.

With these conclusions, then, that world supplies based essentially on wood are in a promisingly healthy position, and that raw materials like straw and bagasse can add a limited but helpful contribution to the total, perhaps with Hebbs[14] we may now sum up the world situation as follows:

(*a*) The recurring "shortage" conditions in world cellulose supplies follow from the demand temporarily outstripping the rate of expansion in pulping capacity and are not due to lack of fibrous raw materials which exist in such quantities and can be grown so readily that no world shortage can yet be envisaged.

(*b*) Artificially high price levels which prevail under "shortage" conditions must not be used as a datum line when assessing the prospects of new pulping projects.

(*c*) Competitive price considerations make it probable that the greater part of the increasing requirements of the world will continue to be supplied from wood sources.

(*d*) Agricultural residues, annual crops, grasses, reeds, and so on, whilst of undoubted value in many instances, seem more likely to be developed for local and specialized uses, providing only a smaller part of the required expansion.

DISCUSSION

MR. H. SANDERSON: I have only one fault to find with the lecturer's excellent address: it is that he did not mention that industry which gives great pleasure by beautifying the homes here, and all over the world. As he supplies the wall-paper industry with his papers, I think he should, perhaps, have shown what a good thing he is doing in that way.

THE LECTURER: Thank you, Sir, for filling in that omission.

BRIGADIER J. W. P. MACNAIR: The lecturer started off with rather horrifying figures about the consumption, one might almost call it wastage, of raw materials that occurs, and these naturally cause a certain amount of panic. He modified this towards the end of the lecture by pointing out that there is actually no shortage of wood in the world. It seemed to me, from the figures that we saw and from what we know from our own experience, that there are other possibilities, and I should like to ask the lecturer if he does not think this is the case.

Anybody who has visited the United States must have been appalled by the wastage that occurs in paper, not only of newsprint, but of every other kind, particularly when he has seen the enormous newspapers that are shoved through the doors each morning, which nobody reads. That paper is all lost. I think the fact that we are in some ways more advanced than the United States is shown in our slightly more economical conservation of our materials, of which paper is only one.

I should like to ask the lecturer if he has not felt that there is, or might be, a movement in the United States, where they are after all just as ready to learn from other people as anywhere else, towards economizing these rather vital raw materials.

Between the two wars and during this last war, I had the honour to serve in, and eventually to control, the Research Department at Woolwich, which may be said to

be the home of practically all modern explosives, at any rate all those for military purposes, although we have had a hand in other explosives as well. During the war we were affected by this general unease about the lack of materials. The kind of materials used, of course, for explosives of the cordite type is essentially cellulose, and in the first place we used cotton quite happily, based on gun cotton which has to be dissolved.

Well, the supply of cotton was quite clearly running short, and we did a great many experiments with all kinds of things. We used to go to Plumstead Marshes and cut various weeds. We found we could make quite good cordite out of straw. The difficulty there is that the cellulose has to be dissolved, and nearly all the kinds of material you get have little blobs, and they do not dissolve very well. Eventually the situation was eased by finding that we could get quite sufficient wood for our purposes, and wood gives the best results.

It is rather interesting that when you take cotton you can dissolve it into cordite straight away, but when you use wood you have to make paper of it first. It is one of the unusual uses of paper: having made it, you cut it into strips, then dissolve it and turn it into something that you are going to blow up.

I should like to make the point that in the Research Department of Woolwich the work on this problem had tremendous assistance from the paper-makers of England, and I think it is not too much to say that the defence of this country owes quite a lot to the assistance given by them.

There are just two further questions I should like to ask the lecturer. One is about the wonderful old parchment, that he did not mention, on which legal deeds, early books and things were written, and which we now see sometimes used for electric lamp shades. What is the peculiarity of that parchment—I ought to know but I am afraid I do not—which makes it differ from ordinary paper and makes it last practically for ever? The other question I want to ask is why the Chinese very long-fibred grass which the lecturer said was not used for paper, was not in fact used for this purpose. It has such a very long fibre, it is made of cellulose, therefore it ought to have the hydrogen bonding, and yet the Chinese grass cloth made from that material is extremely fragile and does not last very well. I was wondering if the lecturer could tell us why that long-fibred grass is not satisfactory.

THE LECTURER: I did not, I think, say that long fibre is not used. Very long fibres are rarely used without cutting before they are made into paper.

The parchment which the speaker referred to must, I think, be genuine parchment. It is not made of vegetable fibre at all, but it is of animal origin being prepared from the skins of sheep and other animals. It is, therefore, quite different from paper.

With regard to the American newspapers, it is always hard to visualize the cutting down of quantities to which one has become accustomed, and one of the causes of their huge consumption is their advertising. The United States is a country where a tremendous amount of selling is effected through the medium of advertising and through the post; much more so than here where we have such a small area of country in relation to population.

MR. S. C. CALDER: I should like to ask Mr. Underhay if he would tell us what his personal feelings are on the development of straw as a paper-making material in this country? Does he think the supplies could be increased, and are they sufficiently stable from year to year to provide a suitable paper-making material for considerable development?

THE LECTURER: That is a very big question, and I am sorry I did not have more time to deal with it. The position is that straw can and does make good paper.

The quantities which have been said to be available in this country, however, have by no means always turned up when they were wanted. This has discouraged paper-makers from laying down too much capital for straw pulping. But straw is a material that, within its quality limits, can be used profitably, and if it should be possible to have more of it regularly available, I think the paper-maker would make more use of it.

MISS E. L. HOOPER: I am afraid this is a very elementary question: could the lecturer tell us what substances are used for imitation art paper?

THE LECTURER: China clay is loaded into the paper in substantial quantities, 20 per cent, 25 per cent. The particular finish effect is obtained by a special water-finish calendering process which gives a greater degree of smoothness than you get with ordinary paper. Thus there is no coating in an imitation art paper, whereas a real art paper has a mineral coating applied to it by a separate process.

MR. K. W. LUCKHURST (Secretary of the Society): This is not a question, but I cannot resist passing on a little bit of history which may interest you. The lecturer was good enough to refer to the interest which this Society took as far away as the eighteenth century in finding fibrous vegetable materials from which paper could be made direct, in place of rags. One of these which it was thought might be profitable was a specimen of wild cotton down which was sent to the Society from Jamaica. They thought it was rather suitable, and so they sent it to the leading paper-maker of the day, whose name you may have heard of, Mr. Whatman. We have Mr. Whatman's reply in our records. He wrote back and said, "Don't waste your time with that kind of thing, just stick to rags".

THE CHAIRMAN: I am sure you would not want to leave before a very hearty vote of thanks has been expressed to Mr. Underhay for the very comprehensive paper he has given us to-day. It is impossible, in the space of an hour, to talk about all the different makes of paper, uses for paper, and, indeed, to give the full information about the raw materials which are available for the making of paper. I think you will agree with me that Mr. Underhay has taken a great deal of trouble to give us as many facts as he possibly could in that short space of time. Also I am amazed, and I must thank him for this on your behalf, for the great amount of material he has brought along to enable us the better to follow the paper he has given to us.

Paper-making, of course, does go back for many centuries; it is not a new art. But the development during the past hundred years has been, I think I can so describe it, spectacular. I do not know Mr. Underhay's view, but to me progress in the future is a matter for speculation. We have already an example in front of us of the widest paper-making machine in the world. Perhaps there will be development in width, perhaps in quality, and certainly we can be sure that there will be development in quantity.

A vote of thanks to the Lecturer was carried with acclamation: and another having been accorded to the Chairman, the meeting ended.

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ITALIAN RENAISSANCE GARDENS

The Selwyn Brinton Lecture by

G. A. JELLICOE, F.R.I.B.A.

President, International Federation of Landscape Architects, read on Wednesday, 3rd December, 1952, with Gordon Russell, C.B.E., M.C., R.D.I., F.S.I.A., Director of the Council of Industrial Design, in the Chair

THE CHAIRMAN: This is a Selwyn Brinton lecture. Mr. Brinton, who was the author of *The Renaissance in Italian Art*, left a sum of money to this Society, the interest of which was to go to the British Academy of Rome; but for the time being the activities of that body are suspended, so the money is now being spent on an annual lecture on some Renaissance subject.

I think it was in about the year 1929 that I went to look at the boat race at Harold Stabler's house at Hammersmith, and there I was fortunate enough to meet Geoffrey Jellicoe. I remember that we had a long talk on that occasion on the subject of gardening, in which Stabler was knowledgeable, and I had just built a house and was taking an increasing interest in gardening. I learned that he had been a student at the British School at Rome, and was at that time teaching at the Architectural Association; and that with J. C. Shepherd he had just written a book on Italian Renaissance gardens, and another book called *Gardens and Design*. I read both those books, which completely altered my whole approach to the subject of gardening.

The result of that was that I asked him to have a look at my own small garden, and since then he has been, to some extent, my Father Confessor in all kinds of gardening matters; and he did, as a result of this visit to the Cotswolds, make a report, which was the first one, I think, made on any village under the Town Planning Act of 1934, for the village of Broadway in Worcestershire.

Since those days, he has developed from a slightly bashful young man into a very well-known authority on landscape architecture and town planning. He is a Past-President of the Institute of Landscape Architects, and he has been adviser on garden design at Royal Lodge, Windsor, Sandringham and other very well-known houses. He has been Town Planning Consultant to a number of towns and large companies, and is now President of the International Federation of Landscape Architects.

This, I think, is enough to turn any man's head, but he remains without any trace of pomposity and with all his youthful enthusiasms. I do not think anyone has done more to point out the tremendous lesson of the Italian garden, that it must be related to the house, and, on the other hand, that both house and garden must be related to the landscape in which they are.

I have very great pleasure in introducing Mr. Geoffrey Jellicoe.

The following lecture, illustrated with lantern slides, was then delivered.

THE LECTURE

I feel very glad and proud that Mr. Gordon Russell should be chairman at this meeting to-day, because he holds a very distinguished position in the modern world, and he also is interested in history. I think he does see and feel that the study of history has a very great bearing on the problems of the present day.

In this trip that we are going to take into the past, I want you all to bear in mind, if you will, that although we are going into the past there is always one part of the brain which is occupied with what we are doing at the present day.

I am very sorry that we do not have with us this afternoon Mr. J. C. Shepherd, because Mr. Shepherd and I set forth as students from the Architectural Association, and we published a book on Italian gardens of the Renaissance in 1925; and, quite frankly, this is almost the first major talk on Italian gardens I have given since those days. But, because they have been such a vital part of my life and background, I have not been out of touch with them, and when I was so honoured as to be asked to give this lecture I felt that this was the moment to re-assess from the present point of view the whole question of the historic Italian garden design.

All the illustrations, except for the paintings which I shall show you, are taken from our book on the Italian Gardens* and I make no apology about their being old because I know that many of the gardens that will be shown are not in such good condition now as they were twenty-five years ago.

INTRODUCTION

The art of garden design of the Renaissance in Italy was as significant and varied as any art in the history of the world, and if it does not rank in general esteem as high as that of painting, sculpture, and architecture, this is only because its opportunities were less and it was more subject to decay. Nevertheless these gardens illustrate the principles of design probably more clearly than any of the sister arts; for like painting they are pure abstraction and unnecessary to existence, and like architecture they have a content into which one can penetrate and for a while become a part.

The garden is pre-eminently the expression of civilization, and in it are reflected the emotions of man and the way in which he regards himself in relation to the universe. If we consider the history of western civilization over the last thousand years as a series of three chinese boxes, one within another, we may assume the smallest to contain the mediaeval mind, the middle to contain the Renaissance mind, and the outer the modern mind. When we go back in time and enter either of the previous boxes, we are astounded at a realization of beauty that with all our resources and learning we cannot achieve or even approach.

Italian Gardens of the Renaissance, by J. C. Shepherd and G. A. Jellicoe, Ernest Benn, Limited, 1925.

The explanation of this is that the first box was the age of faith and consequently of feeling; the second of reason, but containing a nice balance of feeling and intellect; and the third, our own, one predominantly of the intellect, of the mind traversing great spaces independently of the animal body and therefore tending to be alienated from feeling which alone can make the work of art. The Renaissance in fact had the advantage over our own time in two ways: it knew its objective, and its people were able to communicate this objective through the mysteries of art.

To appreciate fully the Italian garden, it is necessary to understand the exuberance with which the Renaissance began and continued effectively in the physical arts for three centuries. Man discovered himself after the dark ages, and was reinforced in his discovery by the full weight of antiquity which carried him forward as on a mighty wave. His view of his relation to the world about him was quite simple. Man was absolute and his mind would take every advantage of the surrounding world, a world that he found composed of the exciting intricacies of nature on the one hand, and the calm movement of the heavens on the other. All Italian gardens are basically geometric, and their beauty lies largely in the reconciliation of the up-surging, logical, scientific, and ordered mind of man searching for its objective through the wayward ways of nature. The basic materials are grey stone, gravel walks, clipped evergreens, and water; materials that are soft and cool to the senses, but, like those of architecture, unchanging with the seasons. There was no accepted place for flowers, not so much because the climate was unsuitable, as that they formed no part in the scheme of things. In idea there were only two parties concerned in gardens, man and the universe, and nature in any other form except as a kindly provider of materials would have been an intrusion.

The garden was an extension of the house into its surroundings, and the Italian was a master of the delights that play upon the senses: dappled shadows, the patterning of box parterre, the inviting glimpse of distant views, the sound of water, and even, occasionally, the feel of water through unsuspected secret fountains. But these attributes by themselves do not constitute a work of art. The Italian garden is the embodiment of an idea, and everything is directed to enhancing the perception of the visitor and indeed of attaching him to it. The purpose of art is to realize the essence of the subject; this is the difference between architecture and building. If, for instance, Canaletto's apparently exactly painted campanile of St. Mark's is compared with a photograph, it will be found to be more slender than the original. The Idea of an object is in a sense more real than the Real, and this is the reason why in all the great periods of architecture there is often, to the logical modern mind, an apparent straying from the axiom that the exterior should precisely express the interior, or that the materials should not be make-believe. The Italians were unscrupulously untruthful in matters which to them were of no value, but they were strictly truthful in expressing the essence or idea of their conception. The mind that is well balanced between feeling and intellect readily lends itself to these deceits, both gay and sombre, and because of this has a natural passport to the world of ideas.

This world of ideas is based on four essential elements: geometry, the human figure, movement, and environment.

Geometry: This elusive link between the mind of man and the universe has been a continuous subject for research from antiquity to the present day. The Greeks related its shapes, and sequence of shapes, to music; and we know that above even the flowers of the field it is the great promoter of rest, refreshment, and contemplation.

The Human Figure: It is this that gives what Bernard Berenson describes for painting as "tactile values," a feeling that we have been attached to our surroundings. A feeling for the beauty of form of the human nude was a preoccupation second only to geometry, and the emotion of it was breathed into gardens by sculpture, mouldings, balustrades, and all those rounded forms that are but an echo of the human proportions.

Movement: The universe and everything in it is in constant motion, and a work of art must be in movement also. It must be in movement not only in its grand composition, but also in all its details. The mathematical sciences provide movement by repetition of objects, the biological by their fluidity or "flow."

Environment: This fourth element of the arts is more formidable in landscape than in any sister art, not excluding architecture. It has been described as "*genius loci*" and it is one of the wonders of Italian gardens that with all their emphasis on geometry, this geometry appears itself to be the essence of the site whether hilly or flat, wooded or bare.

Nowhere are these four elements revealed more beautifully than in Giovanni Bellini's *Progress of the Soul* (see Figure I).

Geographically the gardens of Italy are fairly evenly distributed northwards from Naples. As with the sister arts, the highest achievements centred round Rome, Florence and Venice. Each of these three great states made a separate contribution to garden art. It may be said in principle that the garden art of Rome was a kind of climax to the contribution of antiquity to the western civilization, the ultimate significance of which is seen in the Vatican loggia of Raphael; that Florence illustrates man poised between the ancient and the modern world as we know it to-day; and that Venice and the Venetian mainland are the springboard of the future. We shall visit three gardens near Rome, three near Florence, and two near Venice, one of which paradoxically has never existed.

ROME

Villa d'Este, Tivoli; Villa Lante, Bagnaia; Farnese Casino, Caprarola

The development of the garden arts always tends to lag behind that of the sister arts, and it was not until early in the sixteenth century, or about two centuries after the Renaissance itself had started in Florence, that the first great classic garden since antiquity was laid out. This was the Villa Madama, a short way outside the city, and built on the lines of a Roman villa by the painter Raphael. Raphael was the greatest master of all time of the composition of objects in space, but the remains are insufficient to show whether he could transfer the three dimensions of a canvas into those of landscape. We must therefore transfer

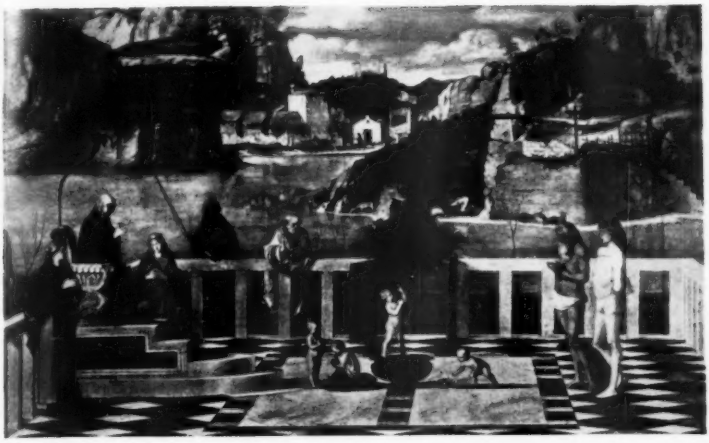

FIGURE 1. *Giovanni Bellini:* Allegory of the Progress of the Soul

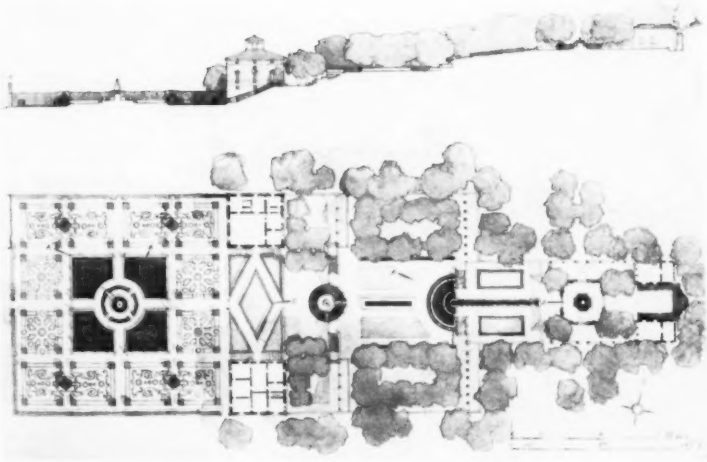

FIGURE 2. *Villa Lante, Bagnaia, 1564: Vignola and Giulio Romano, architects*

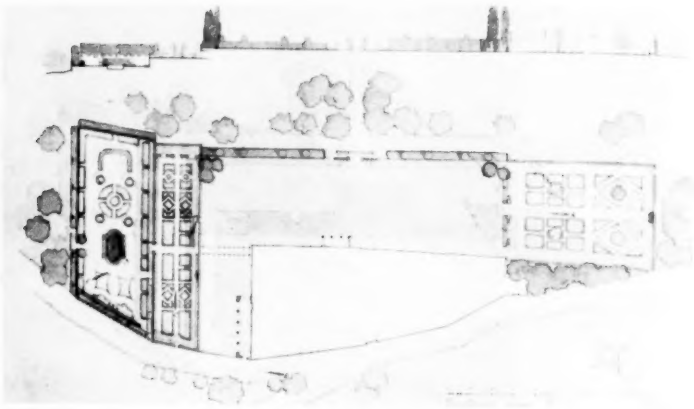

FIGURE 3. *Villa Capponi, Arcetri, circa 1572*

FIGURE 4. *Villa Dona dalle Rose, Valzanzibio, circa 1690*

our garden study for a moment to the work of Raphael's master Perugino, to understand fully the objective of the sixteenth century garden architects in their magnificent achievements in the hills surrounding the capital. Pietro Perugino painted the *Christ giving the keys to St. Peter* in the Sistine Chapel in 1503. Behind the foreground figures is a great patterned space containing a domed building anchored to the earth by four porches penetrating the sky. On either side are classic triumphal arches, as it were guarding the centre building. There are no boundaries and the landscape appears to contain all the splendour of human aspiration of the time: namely, identity with a glorious past leading to identity with the revolving universe itself.

Although the slopes of the hill on which Frascati stands are carved with an unequalled series of gardens, the most important Roman garden is unquestionably the Villa d'Este at Tivoli. This was constructed for Cardinal Hippolito d'Este in 1550 by the architect Pirro Ligorio, out of a site adjoining the town, overlooking the Campagna, and containing great volumes of running water. It has all the drama and splendour and sense of assurance of the Papacy of the time. It is overwhelmingly impressive not only for its architecture, its disposition and even its somewhat robust and crude detail, but also for the sound of its waters which, to the visitor walking about it, varies like the tones of a gigantic organ. The true greatness of the Villa d'Este however lies in the fact that it is an indirect translation of Perugino's picture into reality, causing a sense of fulfilment to follow the sense of wonder.

The development of the Perugino theme in painting lay in Raphael's *Lo Sposalizio*, now in Milan, and in architecture in Palladio's Rotonda at Vicenza, the last of the villas that we shall visit. Standing as an offspring without a future, but possibly more beautiful than either, is the Villa Lante at Bagnaia, about forty miles north of Rome (see Figure 2). Begun a few years after the Villa d'Este by Vignola and Giulio Romano, Lante has been felt by many to be the most contemplative garden in existence. It contains the elements of the Perugino picture, the place of the domed building being taken by the parterre and Giovanni da Bologna's fountain, and that of the classic arches by square twin houses. But the place of the beholder in the picture is taken by nature, from which runs forth a series of geometricized cascades and rivulets to feed the central pools. The details are as exquisite and as lovely as the idea, and it is perhaps the only famous Italian garden where man takes second place in the great scheme of things.

If the Villa Lante gardens contain the sense of geometry and *genius loci* in a way beyond the range of painting and even of architecture, Vignola's second garden masterpiece is without parallel in its sense of tactile values and movement. The Casino of the Farnese Palace at Caprarola was completed in 1587 for Cardinal Alexander Farnese, nephew of Pope Paul III. It can be truthfully described as tremendous fun, fun that is no less fun after four hundred years. The scale is heroic, and, characterized by the caryatid, it argues the most shrewd understanding of human nature and of the faculties with which the human being is endowed to enjoy his existence.

The spirit of the Roman Renaissance garden sprang from that of Imperial Rome and later passed into the great lay-outs of the reign of Louis XIV in France. It was only for a short time in its history that this kind of garden expressed anything other than materialism, for at all times it has been the symbol of organized power and imperialism.

FLORENCE

Villa Medici, Fiesole; Villa Capponi, Arcetri; Villa Gamberaia, Settignano

The Renaissance was heralded in the fourteenth century by Dante, Petrarch and Boccaccio in the city of Florence. Although it is described as the rebirth of man after the middle ages, this is more strictly true of Rome than of Florence. For the Florentine was less monumental and more humane, and within a minor orbit we can follow the creation of all-round man. Everything is smaller, more tender, and more varied. Even the landscape of the Arno valley is small compared with the Roman Campagna. The spirit of enquiry was abroad and man's interest in himself as man the individual extended to surrounding nature and especially to flowers and plants. Leonardo da Vinci in many ways epitomized the Florentine; although he was the most eminent scientist of his age, it would seem that he held science as subsidiary to and not master of his art as a painter. His portrait of Ginevra de' Benci conveys the idea of how close humanity in reality is to nature and therefore how the beauty of one is associated with that of the other; his *Last Supper* gives direct meaning to geometry as leading to the ultimate peace of the world.

The Villa Medici at Fiesole was built by Michelozzo Michelozzi for Lorenzo de Medici in 1458 (see Figure 5). It antedated the Villa d'Este therefore by nearly a century. Although some of the façades have been remodelled, and the lower parterre is modern, the original composition is complete. The terraces have been carved out of the hill overlooking Florence a few miles away, and it may be the earliest villa of its kind where the interior of the house has been projected externally not as an enclosed garden but as a great view terrace. It is formed of a minimum number of geometrical solids but these are so sympathetic to their position as to have become part of their environment. The Platonic Academy no doubt met at the villa and the long simple lines of the terrace and the rhythm of the parts are the counterpart of their deliberations.

Very different but equally attractive is the Villa Capponi at Arcetri in the suburbs of Florence (see Figure 3). This was built about 1572 and is therefore contemporary with the Farnese Casino at Caprarola. Both are baroque, from that period of pronounced movement in architecture, but they are as different one from another as is Botticelli from Michelangelo. The Villa Capponi is not monumental; it is domestic. Like the Villa Medici its lay-out is very simple, but it plays more upon contrast in open and closed spaces. There is a long grass terrace overlooking Florence, and then steps lead down into a sequence of two enclosed gardens. These rooms without a ceiling contain the usual carpet of box parterre, but, unlike the stately Roman gardens, they also contain freely growing flowers and plants that have crept in unasked rather like those in the *Birth of*

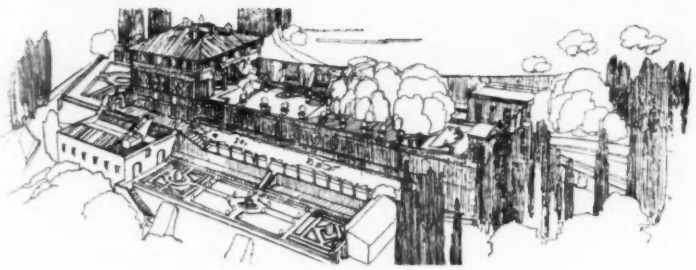

FIGURE 5. *Villa Medici, Fiesole, 1458; Michelozzo Michelozzi, architect*

Venus. The tops of the walls are exciting and pure fun. One is not moved to awe, or wonder, or even contemplation, but to a sensuous enjoyment of the moment and an irresponsible animal pleasure in existence.

Very different again is the Villa Gamberaia at Settignano, some eight miles north east of Florence and built about forty years later in 1610. (Figure 6.) Renaissance man has grown up and passed into maturity, and he now sees the full significance of the individual human mind. This sense of responsibility is brought out in contemporary portraiture, and never more so than in the work of Bronzino, who influenced even more than Raphael the future study of man through this medium. Bronzino shows humanist man brought to the point where humanism can no longer be the primary aid in his journey through the ages. It is as though for the first time he realizes the significance of two factors momentous to the future of the world: that the individual human mind has greater potential power than the whole of the physical universe; and that this demoniac force lies dormant not merely in the leaders but in every human being great or small. The Villa Gamberaia is probably still the most interesting existing garden where all aspects of the well-balanced individual mind find their counterpart in physical environment. It was a tragedy of the Second World War that the house was burned out and is now derelict.

The villa is set somewhat like the Villa Medici upon the hillside overlooking Florence and the Arno valley. There were indeed countless villas lying on the olive clad slopes facing in upon the mother city, where Brunelleschi's dome rose majestic among the towers and spires and closely clustered roofs. The site was awkward, but the components are so arranged that the odd boundary might have been drawn after the design was made, which is not the case. There are innumerable contrasting elements in the garden, and these are disposed round a long and stately alley on the one hand, and a jocular grotto garden on the other. Two ilex *boschi* contrast with the gaieties of the formal garden. The elegant lemon garden has its appropriate place. The dark depths of the lofty cypress grove contrast with the openings that look upon the assured and pleasant outer world.

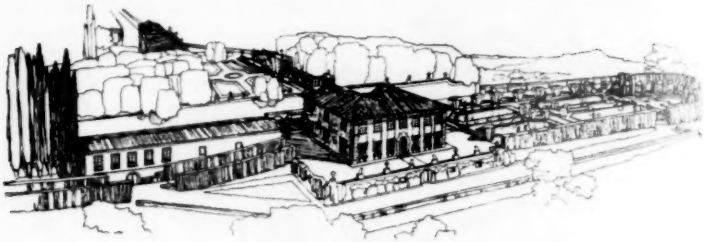

FIGURE 6. *Villa Gamberaia, Settignano, circa 1610*

VENICE

Villa Dona dalle Rose, Valzanzibio; Villa Rotonda, Vicenza

The assured and pleasant outer world was nowhere so apparent as in the third great centre of the Renaissance, the Republic of Venice. The roots of Venice were not in antiquity, like Rome, nor in its environment, like Florence, although its water environment was in fact unique and profoundly affected its architectural forms and sense of colour. Venice lay on the great trade route between west and east, and its civilization drew its nourishment not only from Italy itself, but from as far north as the Netherlands, and as far east as Persia. It was therefore cosmopolitan and at an early age was peculiarly sensitive to world movements. As a people the Venetians were pleasure-loving and devoted to themselves as citizens in the aggregate rather than as individuals. They were an oligarchy rather than a family or a papal state, and over centuries of internal peace were able to develop a way of life that is the basis of the modern world. They were keenly interested in the mainland and at least two painters heralded an outlook on landscape far in advance of any in the rest of Italy. The first is Giovanni Bellini (Figure 1) who placed the geometry of the new world within the mediæval conception of landscape; and the second is Giorgione whose landscape backgrounds are the first to suggest that organization of space that culminated in the eighteenth century English park. Bellini's design foreshadows the Villa Dona dalle Rose at Valzanzibio, and Giorgione's background to the Castelfranco *Madonna* leads to what should be the appropriate environment of the Rotonda.

The Villa Dona dalle Rose lies in the Euganian hills about twelve miles south west of Padua. It is said that the gardens were made about 1690 by Antonio Barbarigo, Doge of Venice, nineteen years before the house was built and came to be inhabited. The general plan is a simple rectangle, and is somewhat like a paradise carpet that has been laid gently across the valley within an amphitheatre of hills, being attached at either end by avenues. The plan has clearly been influenced by the Villa d'Este at Tivoli, but it is as distinct from it as Venice was from Rome. Within its apparently unsophisticated pattern are many of the secrets of optics and perspective that Tintoretto had explored and exploited in the previous century. There is suggested indeed the hint of a disintegration of

form through duality of purpose: indecision whether the fixed eye of the beholder in the house is to take precedence over the impersonal classic pattern of the falling waters and the remainder of the design. The personality and power of the owner does not permeate the design; it is essentially a great garden where crowds may form a part but never so large in any one place as to be excessive. This humane outlook is possibly the nearest approach to the equivalent of the formal English garden of clipped hedges and enclosed spaces. Although the gaiety of its sculpture and ornaments are not easily to be appreciated by Englishmen it is the most agreeable garden in Italy, and one where may be found an echo of the simple streets and squares that constitute an English city of the Renaissance.

The attraction for the Englishman to this north east corner of Italy has been unending. It has been a veritable quarry for ideas. He may have been on the grand tour and admired to a greater degree the works of Florence and Rome, but always he seems to have come back to Venice and the mainland. But Venice had two appeals. It was cosmopolitan and its art contained the world; and associated with it arose one of the most logical and clear thinking architectural philosophers of all time, Andrea Palladio.

The Villa Rotonda stands on the hills outside Vicenza, a hundred and fifty years older than the Villa Dona dalle Rose, and sublimely marks a new era. For the gardens that had hitherto projected the interior of the house into the natural surroundings were all again drawn inwards, and the ideal building of mankind was so united to the geometry of the heavens that it needed no attachment to the earth other than a foothold in idyllic surroundings of nature. The mind of man becomes detached from matter; the building becomes the essence of geometry, the setting becomes the essence of biology. So we can follow this trend throughout history until it culminates in the Palladian house and park of the English eighteenth century. It is agreeable to realize that the aristocrat of this period, probably the greatest cultural force in the world at that time, was the heir of that same Renaissance youth who had first appeared in Florence so joyously four hundred years before.

THE CHAIRMAN: I think nearly every Englishman wants to go to Italy: it is a sort of natural urge we have, and I am sure everyone in the room here will feel, after the admirable address we have listened to by Mr. Jellicoe, that he wants to go again more than ever.

A great many people have written about Italian gardens: Edith Wharton, Vernon Lee, and Sir George Sitwell in his little book *On the Making of Gardens*. Edith Wharton, in talking of the garden magic of Italy and trying to estimate what it was, said, "If you think away all the elements of the garden, its antiquity, its size, its magnificence, and the stone and all the other things, still something remains". It is an intangible something, extremely difficult to define; it is really the brooding spirit of the garden which is so impossible to translate, and I feel, in so many Italian gardens, so-called, which have been built in other countries, that that particular aspect has been lost.

I feel that we all, thanks to our lecturer, have learned a great deal more about the subject, and I hope that you will show your appreciation in the usual way.

The vote of thanks to the Lecturer was carried with acclamation, and the meeting then ended.

GENERAL NOTES

"DRAWINGS FOR PICTURES" EXHIBITION

An Exhibition of "Drawings for Pictures" has been arranged by Mr. David Sylvester to show some of the many ways in which the contemporary artist uses his drawings in the creation of a painting. Photographs of most of the finished pictures, which will include works by Victor Pasmore, Stanley Spencer and Graham Sutherland, will be on view to make it possible for the spectator to study the translation of the drawing into picture, and each artist's method of working will be described in the catalogue notes. The exhibition will be shown at the Arts Council Gallery, 4, St. James's Square, S.W.1, from 11th February to 7th March, before it visits Hull, Manchester and other provincial towns.

CORRESPONDENCE

THE EXPANSION OF FISHERIES

From SIR ALFRED CHATTERTON, C.I.E., F.C.G.I., B.Sc., FOXGROVE LODGE, BECKENHAM, KENT

Reading in the last issue of the Society's *Journal* the paper by Dr. Hickling on "The Expansion of Fisheries in the Colonial Empire", I was much interested in his account of fish farming and fish ponds, chiefly because for many years I was stationed in the South of India where there are between 30 and 40 thousand tanks which serve as reservoirs for the conservation of water for the irrigation of the paddy fields which lie between them. Few of them are of modern origin and most of them are comparatively shallow owing to the gradual deposit of silt in the course of centuries. They are in the main filled with water in the later months of the year by the north-east monsoon, and the water is used on the cold weather crops. By the beginning of the hot season most of these tanks are dry, but it would not be either a difficult or expensive matter to create more or less permanent pools by means of internal banks or by the removal of some of the silt in selected spots. As a matter of fact the ryots in a haphazard way cart considerable quantities of the silt on to their fields as they recognize that it is valuable as a fertilizer. Probably it would not be very difficult to get them to concentrate this work on selected spots which would not dry up so quickly. Dr. Hickling recognizes in his paper that there is a vast field for research on the fundamentals of fish farming, and it seems to me that the Agricultural Departments of Southern India, such as are established in what was the Madras Presidency and the State of Mysore, might be able to do much useful work on determining to what extent tanks can be used or their working régime so modified as to produce a large increase in the yield of fish.

Towards the end of the eighties of the nineteenth century when I first went to Madras, a Mr. Thomas who was then a Member of the Board of Revenue and such a very ardent fisherman that he was locally known as "Fish Thomas" had paid much attention to the cultivation of fish in the tanks of Madras, more or less if I remember correctly on the lines of fish farming, and had written a book on the subject hoping that it would induce the local government to do something to carry out his ideas; but in those days *laissez faire* dominated administration and nothing came of his rather strenuous advocacy of fish as a supplementary food for the rural population. It is over sixty years since I read his book and I have forgotten most of it and have

now a very vague idea of its contents except that it seemed to make out a very good case for the objects he had in view. It is possible that Dr. Hickling is acquainted with this book, but if not, I would venture to suggest that it might be worth while to see if a copy of it can be obtained in the library of the High Commissioner's Office in London or in the records of the Board of Revenue in Madras. In these days when there is a world scarcity of food, "Fish Thomas'" work would have excited much more interest than it did seventy years ago, when India was exporting large quantities of cereals and was on its way to formulating a famine code which reduced the problems due to the failure of either or both monsoons in India to making them similar to mass unemployment on a large scale. Now we cannot afford to neglect any potential source of food, and Dr. Hickling has in my opinion opened out a very promising field for investigation, research and experiment commensurate in magnitude with the issues involved.

NOTES ON BOOKS

EUROPEAN CERAMIC ART. *By W. B. Honey. Faber & Faber Ltd.*, 1952. £10 10*s*

Nothing like Mr. Honey's monumental work on European ceramic art has ever been attempted before. The plan of the book, with its cross references, bibliographical notes, classified index of marks, and diagrams of forms, is admirable. The longer articles, such as those on "Engraved Designs" and "*Hausmalerei*" provide useful comparative information. Definitions of categories, foreign terms, modes of decoration, ceramic materials, and pigments, abound. Six excellently drawn maps pinpoint the position of European ceramic sites, and there are some three thousand marks, drawn by the author, "a large proportion" at first hand.

Pottery has never been exhaustively studied in relation to international developments in European art. The general notes on Baroque, Rococo, Neo-Classic, and Empire, might therefore have been supplemented by notes on international Gothic in relation to Italian maiolica, the interaction of Chinese influences upon Mannerism, which is clearly evident in Nevers faience, and the relationship of the growth of Romanticism to the Neo-Classic movement.

Mr. Honey's sensitive appreciation of the craft of the potter is plainly indicated in his article on ceramic forms, which he says, "may be monumental or graceful; solidly quiet and matter-of-fact, or delicate and nervously sensitive. They may appear to be cold and still, or actively growing, dynamic, bursting, swiftly rotating or slowly ascending as they turn". He is no less happy in his assessment of the quality of decorative processes. In describing transfer-printing he notes the "charming results obtainable with good engravings frankly accepting the conventions of the medium".

The article on forgeries will, no doubt, meet a real need, for Mr. Honey deals in turn with every class of wares. He has some illuminating things to say about tell-tale abrasions, refiring "dirt", too obvious wear and damage, faked marks, misuse of genuine undecorated goods, dishonest use of old moulds and engravings (of particular importance because of the renewed popularity of certain classes of Victorian pottery), and contemporary imitations. He knows all the pitfalls facing the collector.

Rather less satisfactory are some of the entries concerning English pottery. It is difficult to understand why, in a book ostenstibly ending about 1815, the business started by Sampson Smith in 1851 should be included, and important early nineteenth century firms left out. Although foreign technical terms abound, you will look in vain for "Block-printing", "Mocha", "Spit-out", or "Twiffler", and although I searched diligently I could find no reference to Isa Wood, Obadiah Sherratt, Richard

Meir Astbury, or Joseph Mongenot. Again there are many items where a person is stated vaguely to have worked at the beginning or end of a century, when precise information could have been given. Nor is it easy to understand why Mr. Honey included a list of public collections so obviously out of date. The English section of this entry could have been corrected and annotated without much trouble. The references to the Tofts at Leek and Rushton Spencer, and the omission of important evidence relative to the Toft families in Stoke-on-Trent are misleading. The Tofts are mentioned frequently in Stoke parish registers from 1638 onwards, and in the Hearth Tax returns for Shelton and Bucknall (near Shelton) in 1666. There are also a number of minor factual errors, notably under Aynsley, Hollins, Lakin & Poole, Elijah Mayer, Neale & Bailey, New Hall, Palmer, Pratt, Rogers, Sands, and Turner.

These blemishes, and they do not amount to much in a work of this magnitude, underline the need for further and more exhaustive research into the origins of the potter's craft in Staffordshire and its subsequent industrial development.

While the connoisseur will find here valuable information on various aspects of ceramic *expertise*, those who are curious about the social uses of pottery and porcelain will find Mr. Honey's book a quarry of out-of-the-way knowledge. Here you may learn something about the mysterious perfumed pottery of Talavera, the maiolica dishes built into the walls of some Italian churches, the medicinal clays of Lemnos, the cult of porcelain rooms, pottery gravestones (Staffordshire examples are quoted, but the terra cotta grave insets made by Jonathan Harmer in Sussex are not included), tea-table wares, the traditional peasant art of Moravia ("Habaner wares"), glazed earthenware stoves, even the taws used in the Victorian game of carpet bowls.

The encyclopædic range of Mr. Honey's enquiries into the ceramic arts of Europe has resulted in a compendium of æsthetic criticism and history which will afford much pleasure and instruction.

REGINALD G. HAGGAR

MODERN PUBLICITY, 1952–53. *Studio.* 35*s*

The book before me is the 22nd annual volume of the series, an excellently printed collection of what is, in the opinion of the Editor, the best advertising art of no less than twenty-seven countries. There are six hundred illustrations, including sixty-four in colours, prefaced by a survey of advertising to-day by Sir Harold Bowden, G.B.E., President of the Incorporated Society of British Advertisers. *Modern Publicity* is an essential reference book for all those engaged, however remotely, with publicity and the graphic arts. It is, however, more than that: it is a fascinating picture book, into which one can dip, as into a box of delicious sweetmeats (and, indeed, with six hundred illustrations compressed into 112 pages of reproductions, some of the examples are about the size of a sweetmeat!), in search of particular favourites.

The compression of the current design activity of twenty-seven countries into a book of this size, is, of course, an essentially impossible task, but the result is none the less a valuable survey of advertising art. The somewhat irritating sub-classification of subject matter used in previous volumes has been wisely simplified, so that the material may be grouped into five classes only, and the reader is asked to make comparisons of examples shown on the same page which, in the editor's words, "have some affinity with each other". I confess that the purpose of this exercise escapes me, since, for example, three posters on one page using amorphous shapes to symbolize radio and cablegrams, or two sea-horses used in different posters to symbolize the seaside, merely depress me as indicating the paucity of ideas in the designer's bag of tricks; but perhaps the reason for the grouping may be simply to point out this fact.

Modern Publicity aims to be of value to all those engaged in the advertising professions. There will be many, however, who will find it difficult to reconcile two statements in the Editor's foreword. One of these is that commercial advertising must sell the goods or services of its sponsors "and if it does not fulfil that purpose, however good, clever or imaginative may be the contribution of artist, or copywriter, it has failed".

The other is that "good advertising art must imply good advertising". The first of these statements needs only a little qualification to make it wholly true. But unfortunately the Editor can have had no access to the vital information about results that he needs in order to apply his criterion; the second is, as yet, only wishful thinking and is, I suspect, what the Editor is thrown back on by default of the first.

This does not mean that *Modern Publicity* has no useful part to play, but only that its title is too big for it. As a collection of examples of the ways in which some of the best contemporary artists and designers are meeting their own small but important part of the total problem of selling the goods, it is stimulating, interesting and very worth-while studying.

T. B. WADDICOR

SHORT NOTES ON OTHER BOOKS

PHOTOGRAMMETRIC MAPPING FROM AIR PHOTOGRAPHS. *Iliffe*, 1952. 7*s* 6*d*

This simple explanation of the making of contour maps and plans from air photographs is by the technical staff of Hunting Aerosurveys Ltd. The book is illustrated with photographs and diagrams.

ENCYCLOPÆDIA OF BRITISH EMPIRE POSTAGE STAMPS, 1661–1951. *Volume* 1. *2nd edition. Robson Lowe Ltd.*, 1952. 42*s*

Volume 1 of this encyclopædia, which has now reached a second edition, deals with the stamps of Great Britain and the Empire in Europe.

UNDERSTANDING ART. *By Ana M. Berry. Studio Publications*, 1952. 21*s*

The author seeks, by comparing and contrasting works of art of different kinds, times and traditions, to infer what is common to them, and fundamental to art. Her illustrations are chosen to express the different forms in which a work of art may appear.

THE ART OF FRESCO PAINTING. *By Mrs. Merrifield. Alec Tirant Ltd.*, 1952. 12*s* 6*d*

This book, which was first published in 1846, was the result of Mrs. Merrifield's employment on research connected with the work of the Royal Commission on the Fine Arts, which was to supervise the mural paintings in the new Houses of Parliament. It consists of translated texts on fresco painting, dating from the twelfth to the eighteenth centuries, and an account of the colours used by various painters.

HOW TO IDENTIFY PERSIAN RUGS AND OTHER ORIENTAL RUGS. *By C. J. Delabère May. 2nd edition. Bell*, 1952. 16*s*

This revised and enlarged edition of a book first published in 1920 explains with photographs and diagrams the characteristics of design and weave by which oriental rugs may be identified.

FROM THE JOURNAL OF 1853

VOLUME I. *18th February*, 1853

From the report of a paper on **the History and Manufacture of Boots and Shoes,** ***by*** **J. Sparkes Hall**

It was a proverb, about twenty-five years ago, that "a clumsy boot was till lately a distinguishing mark of a true Englishman abroad."

This, however, could not now be maintained. The French, since the war, had improved wonderfully; and although England had been slow to act, yet now at length our advance in this department of trade was most marked and signal. The improvements effected by the introduction of elastic fabrics, as side-springs, insteps, and waists, were becoming universal; although few persons knew the opposition made to them by elder brethren of the trade, who saw nothing like leather, and would have nothing but leather. The form, also, of our boots and shoes had been bad; and it might be shown that the faults of which Professor Camper, of Leyden, complained, when writing on this subject about 100 years back, were still adopted by many shoemakers, viz.—that of giving the pressure on the very parts of the feet which should have freedom and relief. That more mind had been manifested among the industrious fraternity of shoemakers than had been found amongst any other equally humble class of the community, was almost a truism; and it had been quaintly remarked, that Pope might have had an eye to the profession when he wrote—

"Worth makes the man, and want of it the fellow;
The rest is all but leather and prunella."

Some Meetings of Other Societies

MON. 9 FEB. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. *Is Technical Advertising Necessary or Desirable?* (Discussion).
Geographical Society, Royal, S.W.7. 5.30 p.m. *Marching in Malaya* (Films).
Imperial Institute, S.W.7. 5.30 p.m. J. H. Kouns: *The Colonial Empire: West Africa.*

TUES. 10 FEB. British Decorators, Incorporated Institute of, at the Royal Society of Arts, W.C.2. 6.30 p.m. Sir Ernest Goodale: *Design in Furnishing Fabrics.*
Chemical Engineers, Institution of, at the Geological Society, Burlington House, W.1. 5.30 p.m. S. R. Tailby and Muhammed Aly Saleh: *Heat Transfer from Luminous Gas Flames in Vertical Tubes.*
Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester, 3. 6.30 p.m. G. Christenson: *A Tour in S.E. Australia.*
Mechanical Engineers, Institution of, Storey's Gate, S.W.1. 5.30 p.m. A. H. Ball and W. Nethercot: *Ignition Interference with Television Reception.*

WED. 11 FEB. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. F. C. Williams and G. B. B. Chaplin: *A Method of Designing Transistor Trigger Circuits.*
Petroleum, Institute of, 26, Portland Place, W.1. 5.30 p.m. C. S. Lee and R. O. Young: *Entry Into Oil Operations in Western Canada.*
Sanitary Institute, Royal, 90, Buckingham Palace Road, S.W.1. 2.30 p.m. E. A. Parkin: *Problems of Insect Control in Large Kitchens.*
Victoria & Albert Museum, S.W.7. 6.15 p.m. Sir Owen Morshead: *Windsor Castle.*

SAT. 14 FEB. Horniman Museum, Forest Hill, S.E.23. 3.30 p.m. R. D. Barnett: *Cyrene: A Greek City in North Africa.*

MON. 16 FEB. Geographical Society, Royal, S.W.7. 5 p.m. E. C. Willatts and Mrs. M. G. C. Newson: *Pattern of Population Trends in England and Wales, 1921–1951.*
Imperial Institute, S.W.7. 5.30 p.m. D. J. Parkinson: *The Colonial Empire: Caribbean Colonies.*

TUES. 17 FEB. Industrial Transport Association, at the Royal Society of Arts, W.C.2. 6.30 p.m. N. G. Brookes: *The Trend of the Modern Diesel.*
Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester, 3. 6.30 p.m. T. Hor Rees: *The Mayas and the Incas.*
Refrigeration, Institute of, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. 5.30 p.m. *Novel Refrigeration Cycles* (Discussion).

WED. 18 FEB. British Kinematograph Society, at Film House, Wardour Street, W.1. 7.15 p.m. M. E. Harper, R. L. Hoult and C. D. Staffell: *Process Production in Colour.*
Folk-Lore Society, at University College, Gower Street, W.C.1. 7.30 p.m. Mons. L. Dupont: *The Work of the French National Museum for Popular Arts and Traditions.*
Locomotive Engineers, Institution of, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. 5.30 p.m. A. W. J. Dymond: *Operating Experiences with Two Gas Turbine Locomotives.*
Victoria & Albert Museum, S.W.7. 6.15 p.m. John Summerson: *Hampton Court Palace.*
Wood Education Society, at the Royal Society of Arts, W.C.2. 7 p.m. J. H. Woods: *Soldier into Weaver.*

THURS. 19 FEB. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. J. Cates: *Fluorescent Discharge-Tube Circuits and Operating Problems.*
Road Transport Engineers, Institute of, at the Royal Society of Arts, W.C.2. 6.30 p.m. W. C. Wilson: *Vehicle Development in the Past Decade.*

FRI. 20 FEB. British Sound Recording Association, at the Royal Society of Arts, W.C.2. 7 p.m. T. S. Littler: *The Human Ear and Audiometry.*
Mechanical Engineers, Institution of, Storey's Gate, S.W.1. 5.30 p.m. K. H. R. Wright: *An Investigation of Fretting Corrosion.*

SAT. 21 FEB. Horniman Museum, Forest Hill, S.E.23. 3.30 p.m. Miss Katherine Tousey: *Audubon's America.*